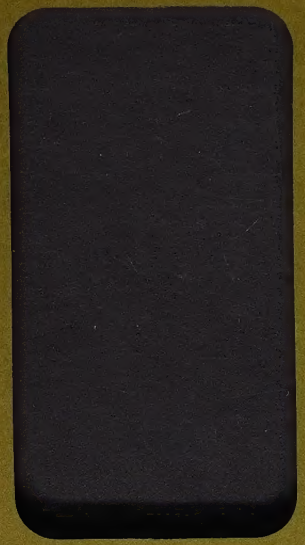
Electronic Services - Los Angeles
M10354X

Beckman

Operating and Servicing Manual

Electronic Instruments Division



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R671618-767-51P

PRINTED IN U. S. A.

MODEL 609-1

Heterodyne Converter

(PREFIX 500)

SERIAL NO._____

Beckman®
INSTRUMENTS, INC.
ELECTRONIC INSTRUMENTS DIVISION
RICHMOND, CALIFORNIA • 94804

SEPTEMBER 1966
(REV. SEPT. 1967)

BII No. 015-436086

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MODEL 609-1
HETERODYNE PLUG-IN

The BECKMAN Model 609-1 Heterodyne Plug-In is a standard BECKMAN Model 609 Heterodyne Plug-In which has been modified as follows:

The front panel has been painted per Federal Standard 595 color number 26373, light grey.

In all other respects this instrument is standard and the following instruction manual will apply.

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SECTION 1

INTRODUCTION

1.1 GENERAL

The Model 609 Heterodyne Converter Plug-In Unit extends the range of the Beckman 25 or 50 MHz basic counter to 952-3002 MHz.

1.2 SPECIFICATIONS

Accuracy:	Maintains the accuracy of the basic instrument.
Frequency Range:	952-3002MHz.
Dynamic Range:	-7 to +13 DBM.
Input Impedance:	Nominally 50 Ω.
Maximum Input:	+20 DBM (2 V rms into 50Ω).
Power Requirements:	+15 VDC and -15 VDC (supplied by basic counter).
Dimensions:	4-3/4" High, 5-3/8" Wide, 11-1/2" Deep.
Weight:	6 pounds.
Operating Temperature:	$0^{\circ}C$ to $+50^{\circ}C$.
Input Reference Frequency:	10 MHz (supplied by basic counter).
Input Connector:	Type N (female).

SECTION 2

OPERATION

2.1 OPERATING INSTRUCTIONS

Three specific cases are demonstrated in Figures 1, 2, and 3. Figure 1 illustrates what happens when the signal is 2 MHz away from a reference frequency (the effect would be similar for other frequencies from approximately 0.5 - 8.0 MHz away from a reference). Figure 2 indicates what happens when the input signal is very close to a reference frequency. One of the difference frequencies in this case will "zero beat" with the signal so no response will result. Figure 3 shows what happens when the input frequency lies midway between reference frequencies approximately 8-25 MHz away).

2.2 PROCEDURE FOR MEASURING AN UNKNOWN FREQUENCY

2.2.1 Install the plug-in unit in the counter. Set the MODE switch on the plug-in unit to the PLUG-IN position.

2.2.2 Set the basic counter controls for EPUT® measurement with the desired time base.

2.2.3 Set the GHz REFERENCE control below 0.95 GHz.

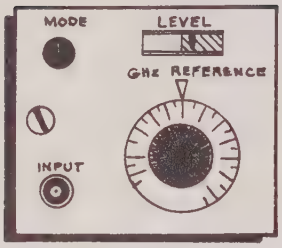
2.2.4 Apply an input frequency between 952 and 3002 MHz, at a level between -7 and +13 DBM (0.1 - 1.0 VRMS).

2.2.5 Rotate the GHz REFERENCE control slowly in the direction of increasing reference frequency until a LEVEL meter deflection in the green portion of the meter face is obtained. Peak the LEVEL meter deflection.

2.2.6 If the counter reading is 52 MHz or less, add it to the REFERENCE GHz reading to obtain the input frequency.

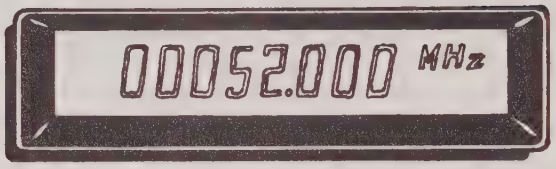
INPUT FREQUENCY 1852MHz

MODEL 609



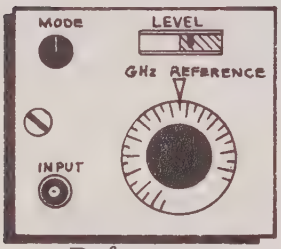
Reference
1800MHz

COUNTER READOUT



Difference Frequency
52MHz

MODEL 609

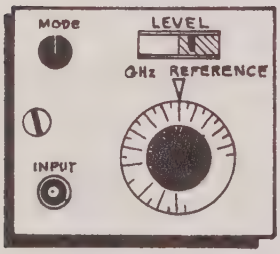


Reference
1850MHz

COUNTER READOUT

Difference Frequency
2MHz

MODEL 609



Reference
1900MHz

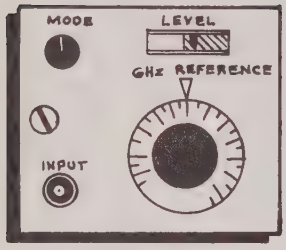
COUNTER READOUT

Difference Frequency
48MHz

Figure 1. Frequency Indication with 1852MHz Input.

INPUT FREQUENCY 1850MHz

MODEL 609

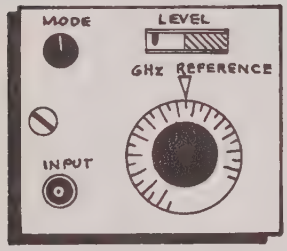


Reference
1800MHz

COUNTER READOUT

Difference Frequency
50MHz

MODEL 609

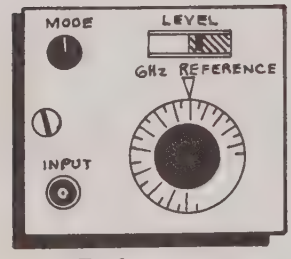


Reference
1850MHz

COUNTER READOUT

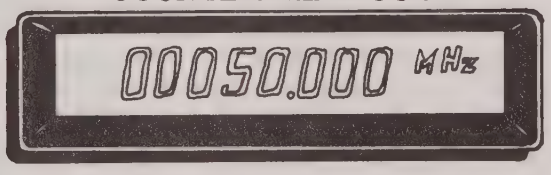
Difference Frequency
0MHz

MODEL 609



Reference
1900MHz

COUNTER READOUT

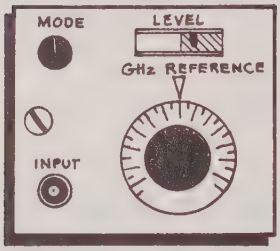


Difference Frequency
50MHz

Figure 2. Frequency Indication with 1850MHz Input.

INPUT FREQUENCY 1824MHz

MODEL 609

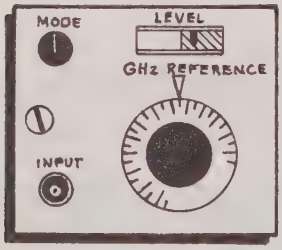


Reference
1800MHz

COUNTER READOUT

Difference Frequency
24MHz

MODEL 609



Reference
1850MHz

COUNTER READOUT

Difference Frequency
26MHz

Figure 3. Frequency Indication with 1824MHz Input.

2.2.7 If the counter reading is greater than 52 MHz, continue advancing the GHz REFERENCE control until a second meter deflection is obtained. Peak the LEVEL meter deflection. The input frequency is now obtained by addition as in paragraph 2.2.6.

2.3 PROCEDURE FOR MEASURING AN EXACTLY KNOWN FREQUENCY

2.3.1 If the frequency of a signal in the range described in paragraph 2.2.4 is exactly known, set the GHz REFERENCE control to a reference frequency which lies from 2 to 52 MHz below the signal frequency.

2.3.2 Peak the LEVEL meter reading with the GHz REFERENCE control, and add the counter reading to the reference frequency to obtain the desired frequency indication (be sure to set controls as described in paragraphs 2.2.1 and 2.2.2).

2.4 AVOIDING CONFUSION WHEN USING HETERODYNE FREQUENCY CONVERTERS

The basic condition to be observed is to exactly follow the operating procedure above. In the interest of better understanding, several of the features of heterodyne units which could result in confusion are discussed below:

2.4.1 Multiple beat frequencies obtainable. When using the heterodyne unit the operator will notice that it is always possible to obtain two, and sometimes three, separate meter responses by tuning the GHz REFERENCE control. In general, these multiple beats arise when more than one difference frequency lies in the video amplifier range of 2-52 MHz. Also, it should be noted that the actual video bandpass will extend beyond the 2-52 MHz range, but the instrument should be used in accordance with the operating procedure so the video frequency falls within these limits.

2.4.2 Second harmonic of reference spurious response. Sometimes it is possible to obtain a small meter deflection (which will not cause the LEVEL meter to indicate in the green region) with a signal at approximately twice the reference frequency. If it is suspected that a deflection is due to this cause, it can be verified by tuning the REFERENCE GHz control in the immediate vicinity of the response. This spurious mode will result either in only one beat being obtainable, or two beats which add up to 100 MHz.

SECTION 3

THEORY OF OPERATION

3.1 BASIC THEORY OF OPERATION

The theory of operation of the Model 609 Heterodyne Converter Unit can be easily understood by reference to Figure 4. Figure 4 illustrates the basic heterodyne technique which is used to reduce an input frequency in the range of 1-3 GHz so that it may be counted by means of a digital counter. The instrument is operated in such a way (see paragraph 2.2) that the beat frequency f_2-f_1 is measured when the input frequency f_1 is above the reference frequency f_2. This means that the reference frequency f_2 being used can be added to the indication of the beat frequency f_2-f_1 which appears on the digital counter, and this addition will result in the exact input frequency f_1.

3.2 DETAILED THEORY OF OPERATION

A more detailed operation of the system can be seen by reference to Figure 5, which is a block diagram of the entire system showing all the functional components necessary for its operation. The actual operation of the unit is slightly more complicated than indicated by Figure 5 in that the frequency f_2-f_1 is divided by 2 in order to reduce the actual frequency fed to the counter, so that Beckman 25 MHz counters can also be used with this unit. In order to compensate for the division of the video output signal, the time base signal from the counter is also divided by 2. The result of this is to make the time base period which is actually used by the counter twice as long as indicated by the time base switch on the front panel of the instrument, but since the video frequency is divided by 2 the net result is a direct readout of f_2-f_1 as would be obtained in the normal case. A brief description of each functional component of the system is included below.

3.2.1 50 MHz MULTIPLIER BOARD

The functions of the MHz Multiplier Board (see Schematic, 50 MHz Multiplier dwg. no. D423812) are to increase the 10 MHz input frequency from the counter to 50 MHz, to filter and amplify the 50 MHz signal to provide a signal suitable to drive the Snap Diode Harmonic Generator. The 10 MHz signal at the input to the 50 MHz multiplier board is first filtered by means of the resonant circuit tuned by inductor L1, and then shaped by tunnel diode CR1 and applied to the

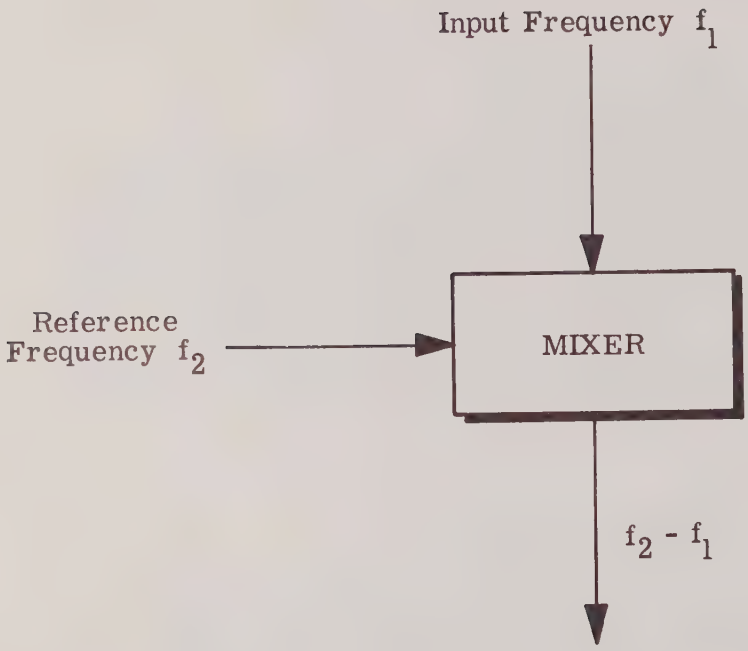


Figure 4. Basic Principle of Operation.

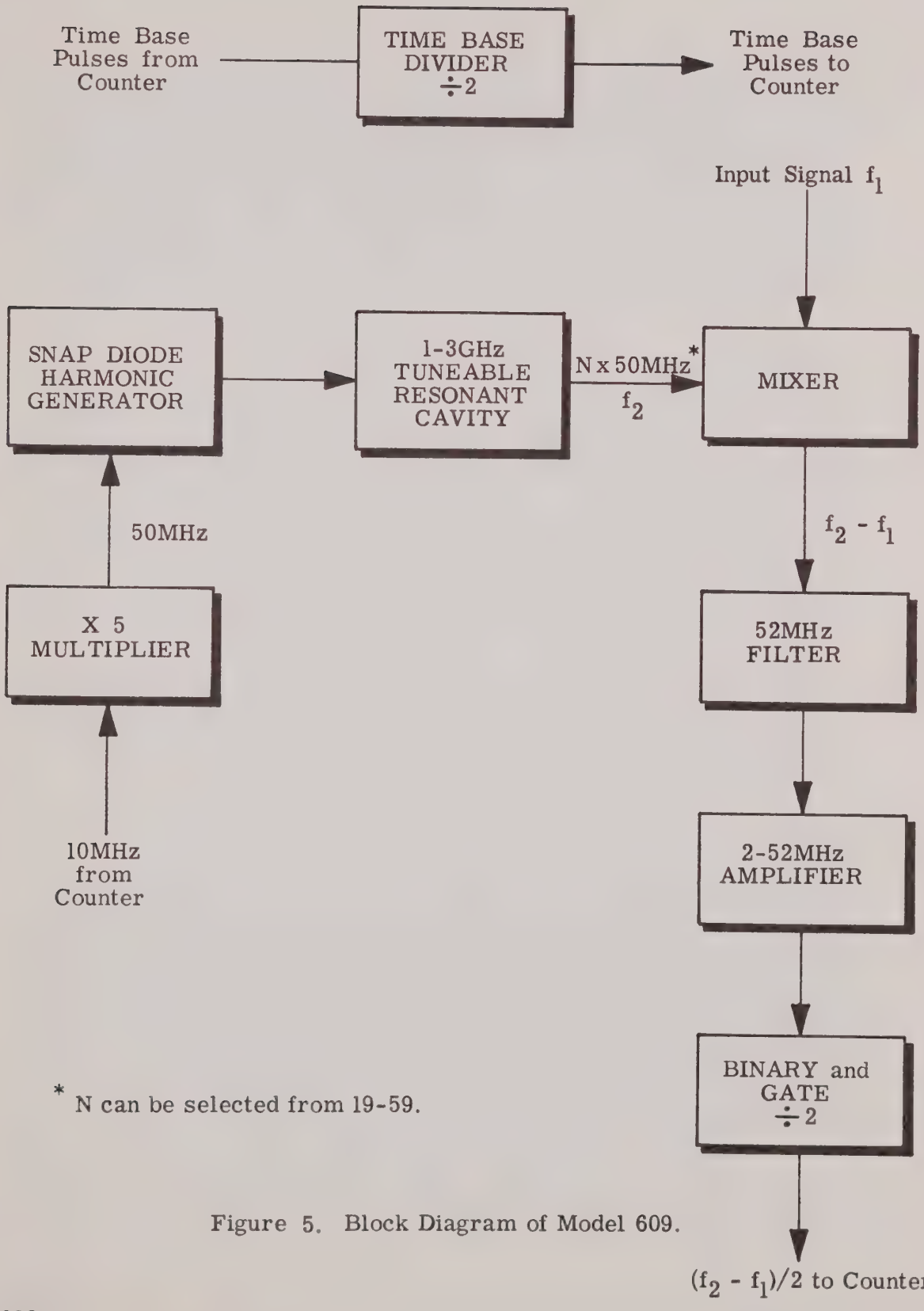


Figure 5. Block Diagram of Model 609.

common base multiplier transistor Q1. The output from Q1 is filtered by the resonant circuit tuned by inductor L2, and then applied to amplifier transistor Q2. The output from Q2 is applied to the 50 MHz crystal filter Y1 through L4, and a voltage of opposite polarity to the voltage on the crystal is developed at the secondary of T1. By careful adjustment of C10, this voltage may be used to null out the effects of the shunt capacitance of the crystal Y1. Capacitor C12 is simply an adjustment to allow the crystal to be peaked correctly on frequency. The output of the crystal filter is fed to amplifier transistors Q3 and Q4 which amplify the 50 MHz signal for application to the Snap Diode Harmonic Generator.

3.2.2. SNAP DIODE HARMONIC GENERATOR

The harmonic generator assembly (see Schematic, Mixer Harmonic Generator, dwg. no. D430929) consists basically of a Class C transistor stage driving a tuned circuit formed by tuneable inductor T1, capacitor C4, and capacitor C19. Transformer T1 is wound using a piece of coaxial cable, the shield of the cable being used as a portion of the resonant circuit. The input signal from the 50 MHz Multiplier is applied through the cable to the base-emitter junction of transistor Q1, and the output is taken from the capacitive tap formed by C4 and C19. A self-bias is developed across the snap diode CR1 by means of potentiometer R2 and resistor R3 (R2 is adjusted at the factory for correct operation of the unit). The Diode CR1 is driven into forward conduction by the waveform appearing across the capacitive tap, and then in the reverse direction until the stored charge on the diode is dissipated, at which time it snaps off in a very brief time. This transition is fast enough so that as it occurs at a 50 MHz repetition rate, it creates a spectrum of energy at 50 MHz increments across the 1-3 GHz band.

3.2.3 1-3 GHZ TUNEABLE RESONANT CAVITY

The tuneable resonant cavity used in this unit is of the capacitively loaded transmission line type, and is tuned over the 1-3 GHz band by means of a moving plunger which slides on a teflon non-contacting short. The plunger is moved in and out of the resonant cavity by means of a non-back-lash drive arrangement in such a way that the motion is linear with respect to the input tuning control. The shape of the tuning plunger is designed to translate the linear motion into an approximately linear tuning characteristic. The input and output from the cavity are taken by means of inductively coupled loops, positioned in such a way as to help provide a constant level of energy at the reference frequency as the cavity is tuned over the frequency range.

3.2.4 MIXER ASSEMBLY

The Mixer Assembly (see Schematic dwg. no. C430929) contains a 3 GHz low-pass filter assembly which is used to remove a spurious reference which is created due to a spurious mode in the cavity. This filter is mounted in a hole inside the assembly and consists of inductors L1 through L4, and capacitors C1 through C3. The inductors and the capacitors are formed from properly machined pieces of metal and dielectric material. The mixer itself is formed by diodes CR1 and CR2,which are point contact silicon diodes. The input to the 2 mixer diodes is applied through a balun assembly formed by ferrite beads L5, L6, and L7.

The purpose of the balun is to provide a transition from an unbalanced line structure to a balanced line structure, so that the voltages which drive the mixer diodes are 1/2 the amplitude of the input signal and approximately 180 degrees out of phase. The reference frequency energy is fed into the mixer diodes by means of capacitors C4 and C5. The value of capacitance used for C4 and C5 is such that the impedance presented to the reference frequency is very small, but the impedance presented to the beat frequency components which appear at this point is quite large. The video frequency output from the mixer is taken through resistors R3 and R4 to transformer T1, which combines the component currents and provides a four-to-one impedance transformation. The video output is taken through C7 into an output cable which is connected to the video amplifier assembly.

3.2.5 Video Amplifier

The 52 MHz filter assembly (see schematic dwg. no. D423820) is formed by inductors L1 through L5, and capacitors C1 through C7 located on the video amplifier board. The filter is comprised of two end sections which are of the M derived type, and three constant K mid-sections. The filter is of the low-pass type, and is designed to roll off slightly above 52 MHz. The amplifier is formed by 4 similar stages (transistors Q1 through Q8) which are designed to maintain a flat frequency response over the video spectrum. The output from the basic amplifier is then passed on to the output amplifier transistor Q9 through Resistor R24. The voltage across R24 is fed into a level detector CR2 which drives a transistor amplifier Q10, the front panel level meter being driven as a part of the collector load of transistor Q10. The DC output of transistor Q10 is applied through a filtering network to the input filter assembly, and thence through R3 to CR1 which is used as an automatic gain control element.

The automatic gain control system functions by detecting when the voltage across R24 has reached approximately 1.1 volts peak-to-peak. The RF signal is then converted to a DC current which turns on diode CR1, thereby shunting the resistor R4 at the base of transistor Q2. This shunting effect lowers the overall gain of the amplifier to whatever level is necessary to maintain approximately 1.1 volts peak-to-peak across resistor R24.

The output amplifier Q9 simply amplifies the current passing through R24 by approximately 2 and feeds the video signal to the Binary and Gate Board.

3.2.6. BINARY AND GATE BOARD

The 50 MHz binary and gate board (see Schematic dwg. no. C428250) is used to quantize and shape the video signal and then divide it by two by means of a transistor binary. The output of the transistor binary circuit is then fed into the digital counter. The quantizing and shaping is done by means of transistors Q1 thru Q5. Q1 is an input matching stage, which provides a current drive to tunnel diode CR1. The tunnel diode quantizes the input signal by re-generating between its two stable states, and drives the current mode pair formed by transistors Q2 and Q3 as it switches between its two voltages states. The amplified output signal at the collector of Q3 is applied to a complimentary emitter follower formed by Q4 and Q5, thus providing a very fast rise time square wave at the emitters of Q4 and Q5. This square wave drives the transistor binary circuit formed by transistors Q6 and Q7 through differentiating capacitors C13 and C15. The output is taken from the binary by emitter-follower Q9, and is then transmitted to the output through diode gate CR6. When the diode gate is to be turned to the off position so no output signal will pass through, Q8 is turned off so that no bias current is provided to the input mode pair or to the output gate.

3.2.7 TIME BASE DIVIDER BOARD (see Schematic, dwg. no. C427437)

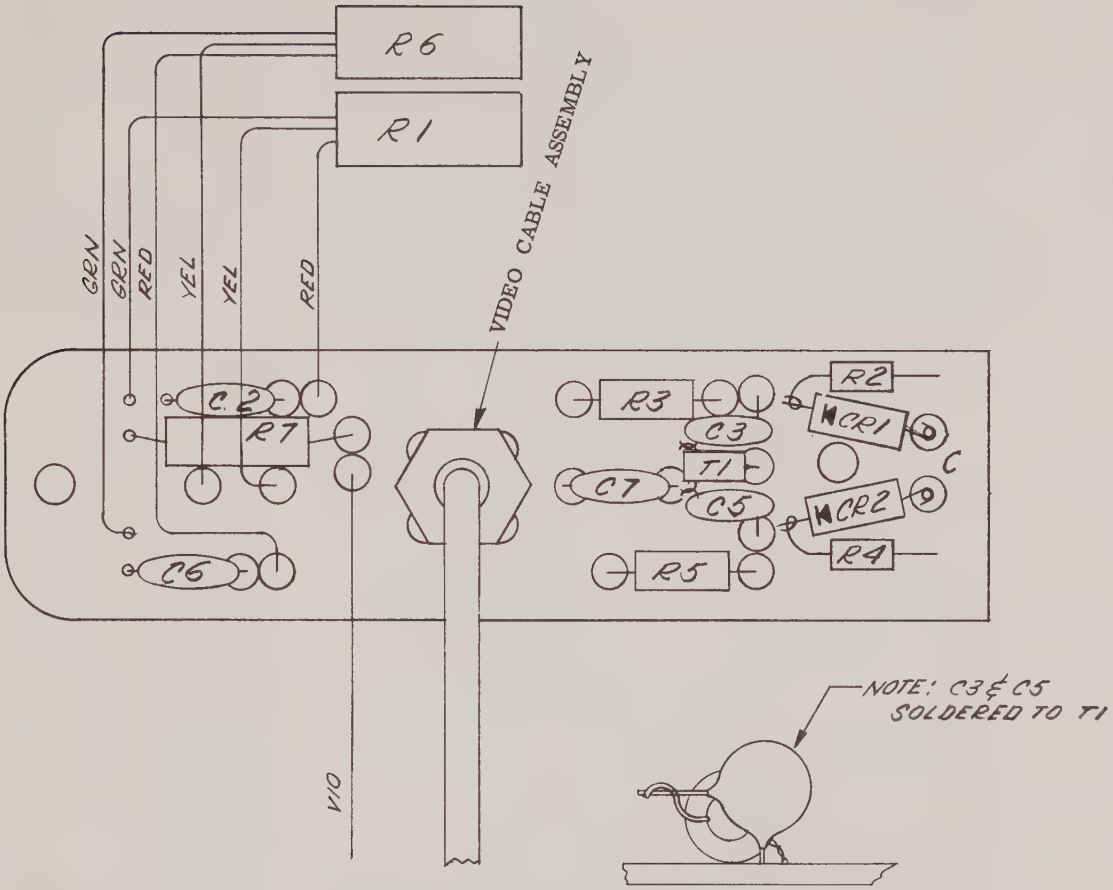
The Time Base Divider Board is used to divide the signal from the time base of the counter by two in order to extend the gate period by a factor of 2. The dividing is done by a transistor binary circuit formed by transistor Q1 and Q2 which are driven through capacitor C3. The signal from the collector of Q1 is passed through emitter-follower Q3 to the Schmitt-Trigger formed by transistors Q4 and Q5. The output of the Schmitt-Trigger is differentiated through capacitors C9 and C10 into the two diode gates formed by diodes CR7 - CR9 and CR8 - CR10. A ground closure to the cathodes of CR7 and CR8 commands the gates to open and pass through positive pulses used to start and stop the counter.

SECTION 4

DIAGRAMS & PARTS LISTS

NOTE

Immediately following each Component Layout Assembly drawing is a parts list (printed on back of drawing) and a schematic diagram. The wiring diagram will be found on page 4-6a.



MIXER BOARD ASSEMBLY COMPONENT LAYOUT

PARTS LIST

MIXER BOARD ASSEMBLY (855-430930)

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
C1		Part of P.C. Board	Beckman	1
C2, 3, 5, 6, 7	633-827605	Capacitor, F.Cerm., 0.01μf, 25V	Sprague 19C604	5
C4		Part of P.C. Board.	Beckman	1
CR1, 2	755-827873	Diode, Silicon, D3530	Sylvania	2
R1, 6	613-857035	Pot, Trim, 10K, 3/4W (Mixer Bias)	Helipot Model 70-C10K	2
R2, 4	601-839620	Resistor, F.Comp., 47Ω, 1/8W, 5%	Allen Bradley BB4705	2
R3, 5	601-822331	Resistor, F.Comp., 8.2K, 1/4W, 5%	Allen Bradley CB8225	2
R7	601-015038	Resistor, F.Comp., 1K, 1/2W, 5%	Allen Bradley EB1025	1
T1	792-423818	Transformer Toroid Wound	Beckman	1
	664-430936	Video Cable Assembly	Beckman	1

HARMONIC GENERATOR ASSEMBLY (855-428268)

C1 thru 8	633-804700	*Capacitor, Bypass, 0.001μf, 500V	Sprague 508C2	8
C2	637-824301	Capacitor, F.Mica, 2000pf, 300V, 5%	Electromotive DM20F202J0-300WV4CR	1
C3	633-811287	Capacitor, F.Cerm., 6.8pf, 600V, 5%	Skottie TCD-4-NPO	1
C4	637-826151	Capacitor, F.Mica, 180pf, 500V, 5%	Electromotive DM15F181J0-500WV4CR	1
J2	697-838675	Connector, Co-Ax, P.C.	Amp 50105-1	1
L1, 8	795-807881	Inductor, 10μH, 460mA	Delevan 1537-36	2
L2	783-807862	* Ferrite Bead	Ferroxcube Corp. 56-590-65/3B	1
L3 thru 7	783-839727	Ferrite Bead Toroid Core	Ferroxcube Corp. 213T050/3E2A	5
Q1	755-838077	Transistor, Type 2N3227	Motorola	1
R1	601-823389	Resistor, F.Comp., 68Ω, 1/4W, 5%	Allen Bradley CB6805	1
R2	611-857074	Potentiometer, Var., 1K, 0.2W, Trim	Daystrom 333 Series	1
R3	626-857118	Resistor, 680Ω, Temp/Sen., TM-1/8	Texas Instruments	1
T1	798-841257	Coil Form (C.T.C.)	Cambion #1536-3-3	1
	661-428131	Cable, Harmonic Generator	Beckman	1

3 GHz CAVITY ASSEMBLY (855-425053)

C19	637-434594	Capacitor, 50pf, Special, Button	Beckman	1
CR1	755-857088	Diode, Step Recovery	Hewlett Packard 0253	1
R5	601-012028	Resistor, 47Ω, 1/2W, 5%	Allen Bradley EB4705	1
R8, 10	611-857036	* Potentiometer, 10K, 2W (Mixer Bias)	Helipot Model 5311	1

*See Wiring Diagram page 4-6a

. . . continued

PARTS LIST

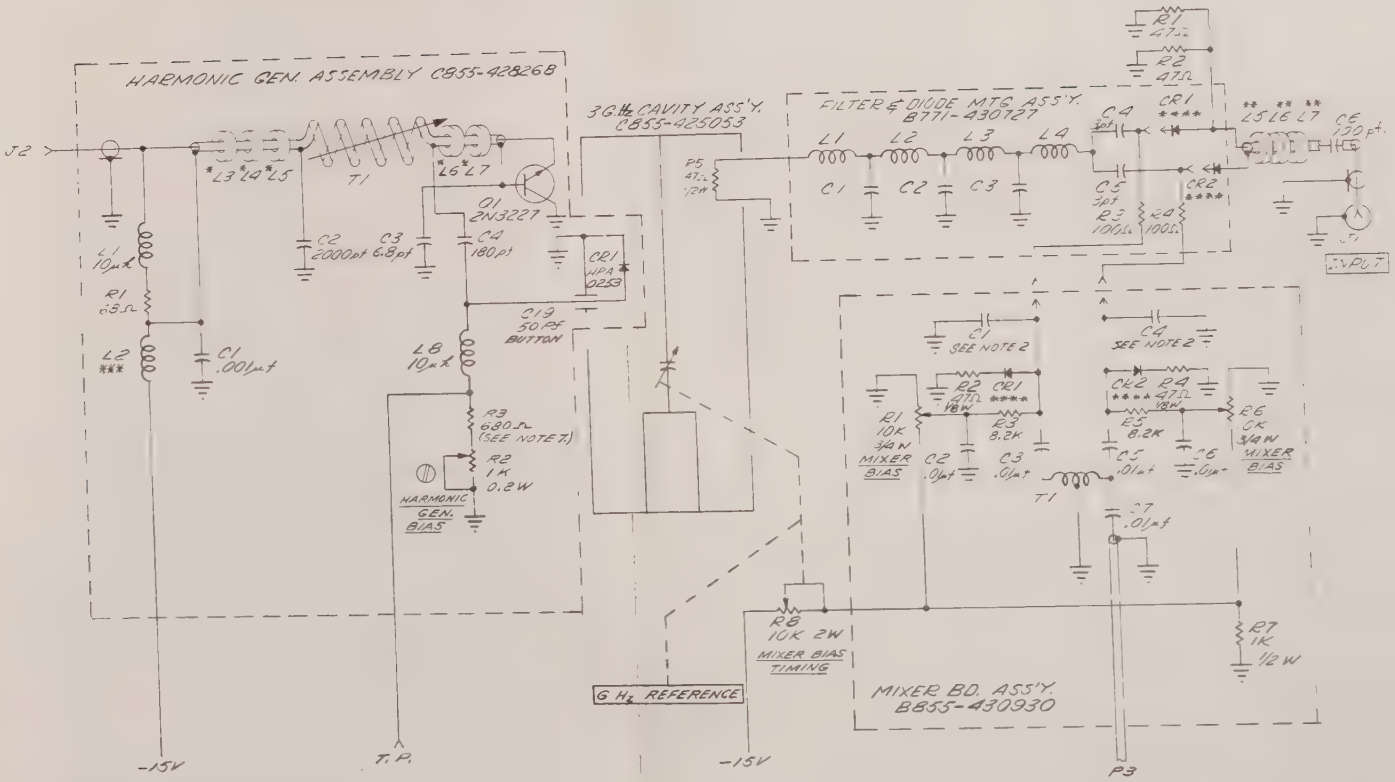
FILTER AND DIODE MOUNTING ASSEMBLY (771-430727)

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
C1, 2, 3		Part of mounting assembly	Beckman	3
C4, 5	633-844566	Capacitor, Cerm., 3pf ±0.5, 500V	Centralab DA108-003	2
C6		Part of Input Connector Assembly	Beckman	1
CR1, 2	755-827873	Diode, Silicon, D3530	Sylvania	2
J1		Input Connector	Beckman	1
L1 thru 4		Part of mounting assembly	Beckman	4
L5, 6, 7		Ferrite Bead (part of mounting ass'y)	Ferroxcube Corp. 266T125/3E2A	3
R1, 2	601-823387	Resistor, 47Ω, 1/4W, 5%	Allen Bradley CB4705	2
R3, 4	601-839628	Resistor, F.Comp., 100Ω, 1/8W, 5%	Allen Bradley BB1015	2

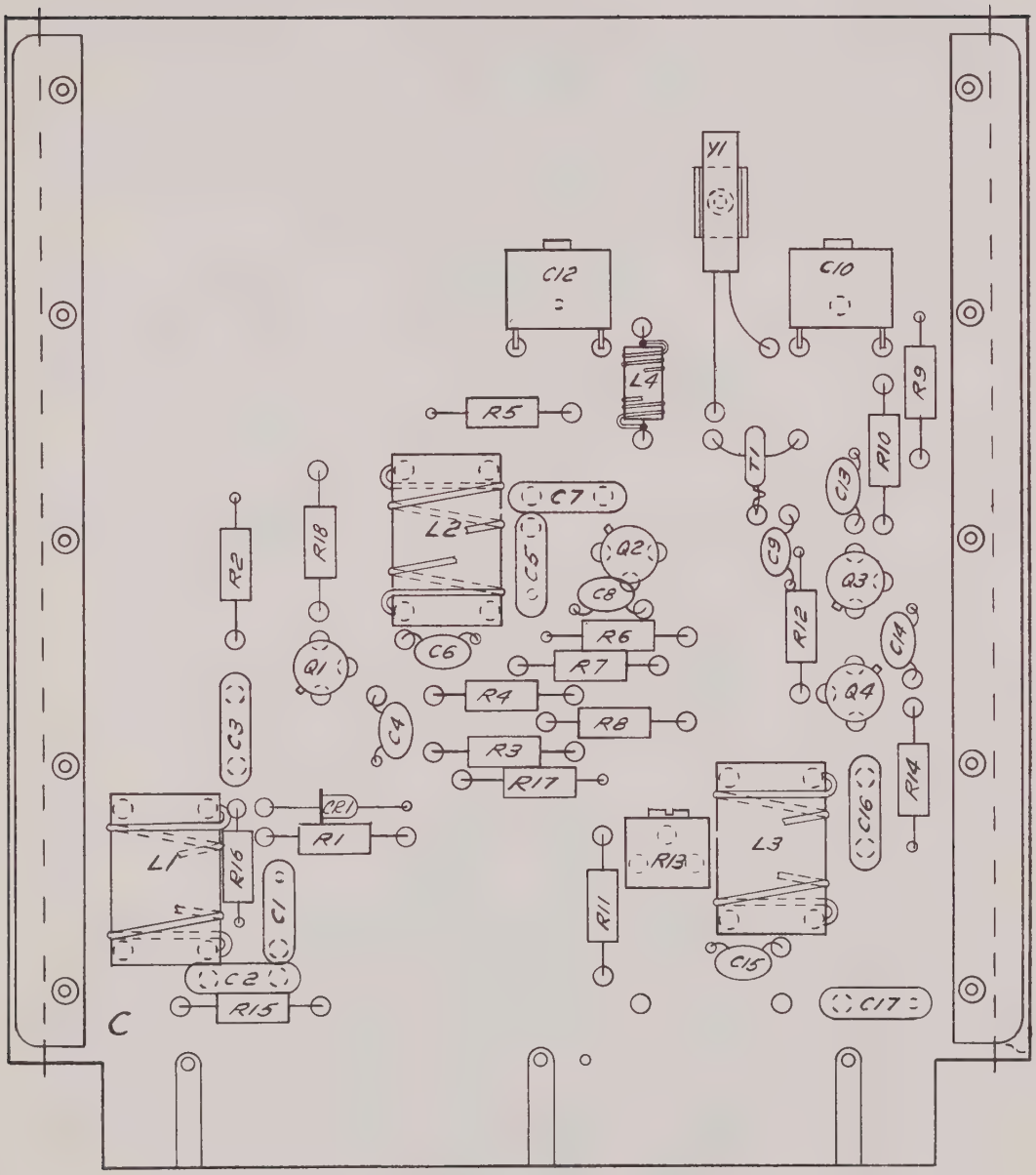
MISCELLANEOUS PARTS

C9, 10	631-841374	* Capacitor, F.Elect., 150μf, 20V, 20%	P.R.Mallory MTP157M070P1C	2
R1, 2, 3	601-823378	* Resistor, F.Comp., 5.1Ω, 1/4W, 5%	Allen Bradley CB51G5	3
	672-824945	* Plug, Connector, 50 pin	Amphenol 57-10500	2
	680-857075	* P.C. Connector, 18 pin	Cinch 250-18-30-170	4
	670-430697	Input Connector Assembly	Beckman	1
S1	711-839401	* Switch, Rotary	Oak, Type 26	1
	325-415351	Knob	Beckman	1
	325-817701	Knob, Black	Raytheon 175-1-2G	1
	809-423826	* Meter, Mod.	Int'l. Inst. #1120 HBL	1

*See Wiring Diagram page 4-6a



NOTES:
1.) RESISTORS —— ¼W, 5% UNLESS NOTED.
2.) MYLAR FILM RF CAPACITORS. NOT A PURCHASED PART, BUT P/O APPROPRIATE ASSEMBLY.
3.) * FERROXCUBE BEAD #213 TO 50/3E2A.
4.) ** FERROXCUBE BEAD #266T125/3E2A.
5.) *** FERROXCUBE BEAD #56-590-65/3B.
6.) **** DIODES ARE D3530 (755-827873).
7.) POSITIVE TEMPERATURE COEFFIENT RESISTOR, TYPE 1/8, TEXAS INSTRUMENTS.



50 MHz MULTIPLIER ASSEMBLY COMPONENT LAYOUT (A1)

PARTS LIST

50 MHz MULTIPLIER (A1)

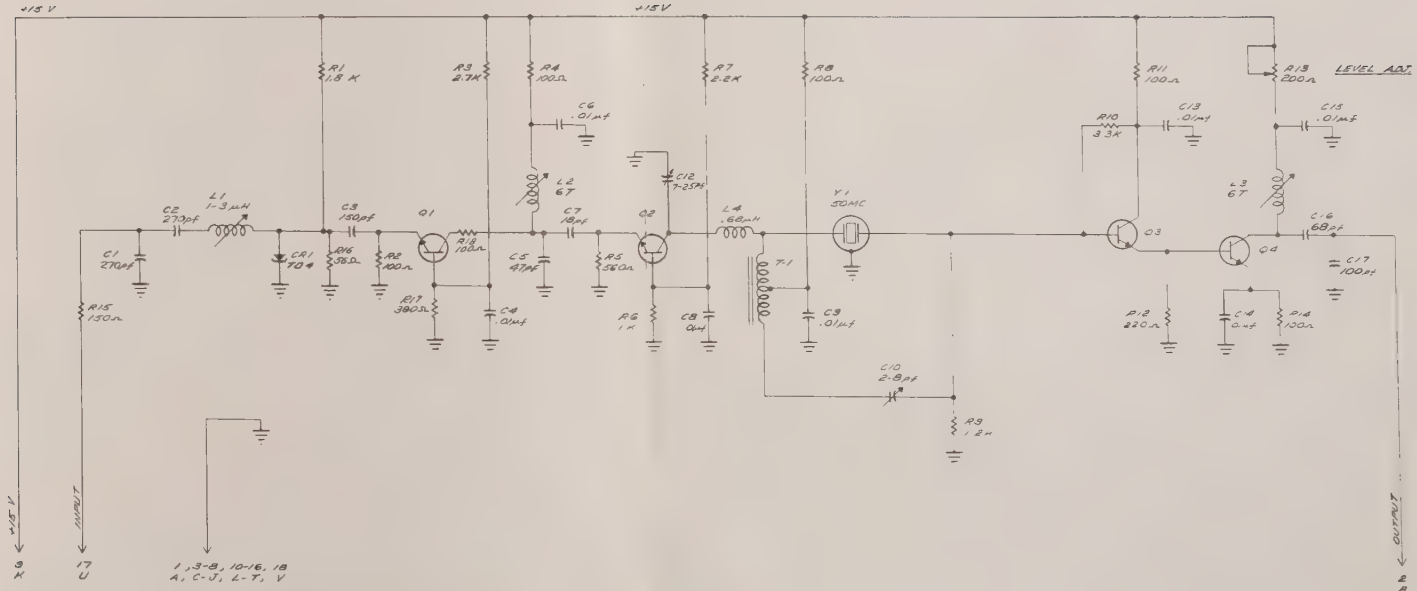
Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A1	887-423815-B	50 MHz Multiplier Board	Beckman	1
C1, 2	637-825813	Capacitor, F.Mica, 270pf, 500V, 5%	Electromotive DM15F271J0-500WV4CR	2
C3	637-825104	Capacitor, F.Mica, 150pf, 500V, 5%	Electromotive DM15F151J0-500WV4CR	1
C4, 6, 8, 9, 13, 14, 15	633-827605	Capacitor, F.Cerm., 0.01μf, 25V	Sprague 19C604	7
C5	637-822754	Capacitor, F.Mica, 47pf, 500V, 5%	Electromotive DM15E470J0-500WV4CR	1
C7	637-827575	Capacitor, F.Mica, 18pf, 500V, 5%	Electromotive DM15C180J0-500WV4CR	1
C10	643-838676	Capacitor, V.Cerm., 2-8pf	Erie 538-006 COPO-89R	1
C12	643-838677	Capacitor, V.Cerm., 7-25pf	Erie 538-006B2PO-93R	1
C16	637-822973	Capacitor, F.Mica, 68pf, 500V, 5%	Electromotive DM15E680J0-500WV4CR	1
C17	637-819448	Capacitor, F.Mica, 100pf, 300V, 5%	Electromotive DM15E101J0-300WV4CR	1
CR1	755-819394	Diode, Tunnel	GE Type 1N3718	1
L1	795-431128	Inductor, Variable, 1-3μH	Beckman	1
L2, 3	795-423816	Inductor, Variable, 6T	Beckman	2
L4	795-807864	Inductor, Fixed, R.F., 0.68μH	Wilco Corp. 203-112	1
Q1, 2, 3, 4	755-838077	Transistor, Silicon, NPN	Motorola 2N3227	4
R1	601-822544	Resistor, F.Comp., 1.8K, 1/4W, 5%	Allen Bradley CB1825	1
R2, 4, 8, 11, 14, 18	601-817735	Resistor, F.Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	6
R3	601-822295	Resistor, F.Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	1
R5	601-823396	Resistor, F.Comp., 560Ω, 1/4W, 5%	Allen Bradley CB5615	1
R6	601-822308	Resistor, F.Comp., 1.0K, 1/4W, 5%	Allen Bradley CB1025	1
R7	601-822328	Resistor, F.Comp., 2.2K, 1/4W, 5%	Allen Bradley CB2225	1
R9	601-822326	Resistor, F.Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	1
R10	601-822296	Resistor, F.Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	1
R12	601-822327	Resistor, F.Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	1
R13	613-854331	Resistor, Vari., 200Ω, Type 62PA	Helipot 62PAR200	1
R15	601-823391	Resistor, F.Comp., 150Ω, 1/4W, 5%	Allen Bradley CB1515	1
R16	601-823388	Resistor, F.Comp., 56Ω, 1/4W, 5%	Allen Bradley CB5605	1
R17	601-822371	Resistor, F.Comp., 390Ω, 1/4W, 5%	Allen Bradley CB3915	1
T1	792-423818	Transformer, 8T, CTR - Tap	Beckman	1
Y1	881-857048	Crystal, 50MHz, 3rd Overtone	MIL-C-2098/CR55/U	1
	864-832780	Transistor Pad	Milton Ross 10034	4

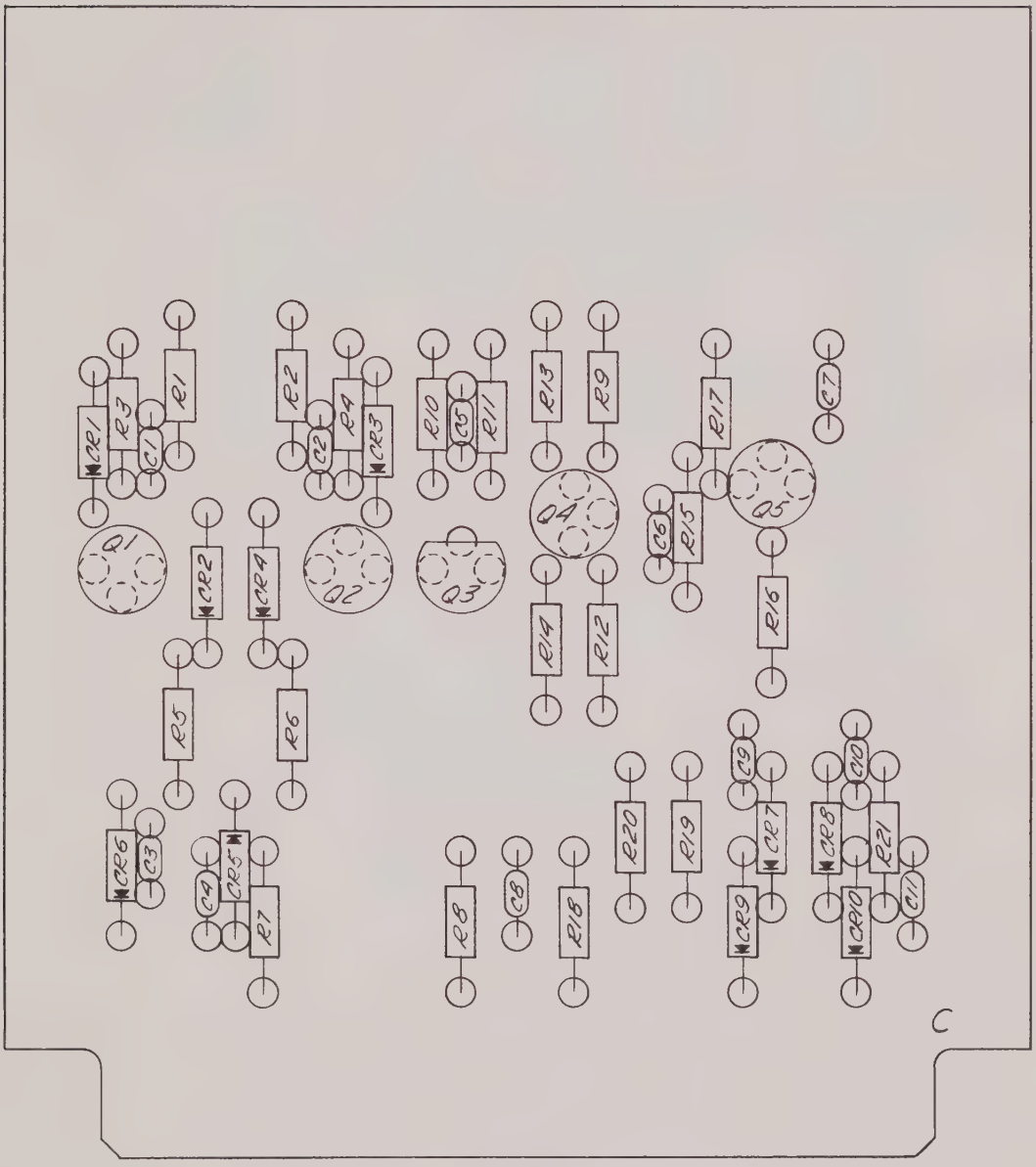
NOTES:

1) ALL .01μf FIXED CAPACITORS – CERAMIC DISC
ALL OTHER FIXED CAPACITORS – DIPPED MICA
– UNLESS OTHERWISE SPECIFIED

2) ALL RESISTORS ¼ WATT, ±5% TOLERANCE
– UNLESS OTHERWISE SPECIFIED.

3) ALL TRANSISTORS – 2N3227



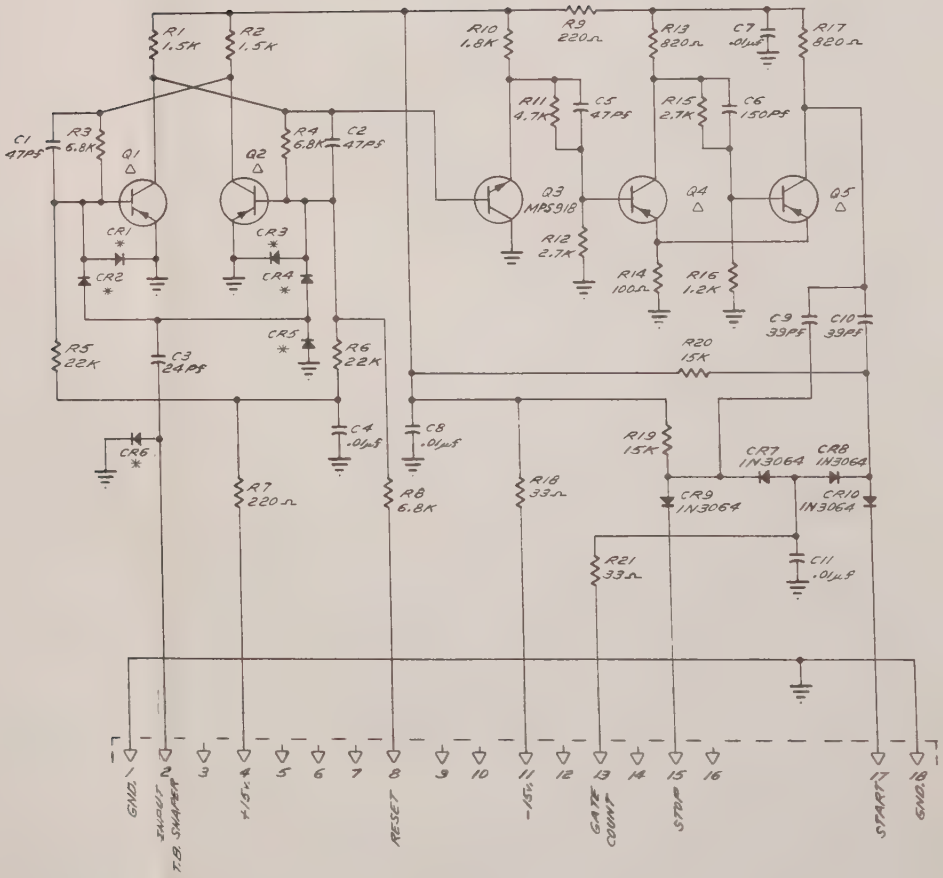


TIME BASE DIVIDER ASSEMBLY COMPONENT LAYOUT (A2)

PARTS LIST

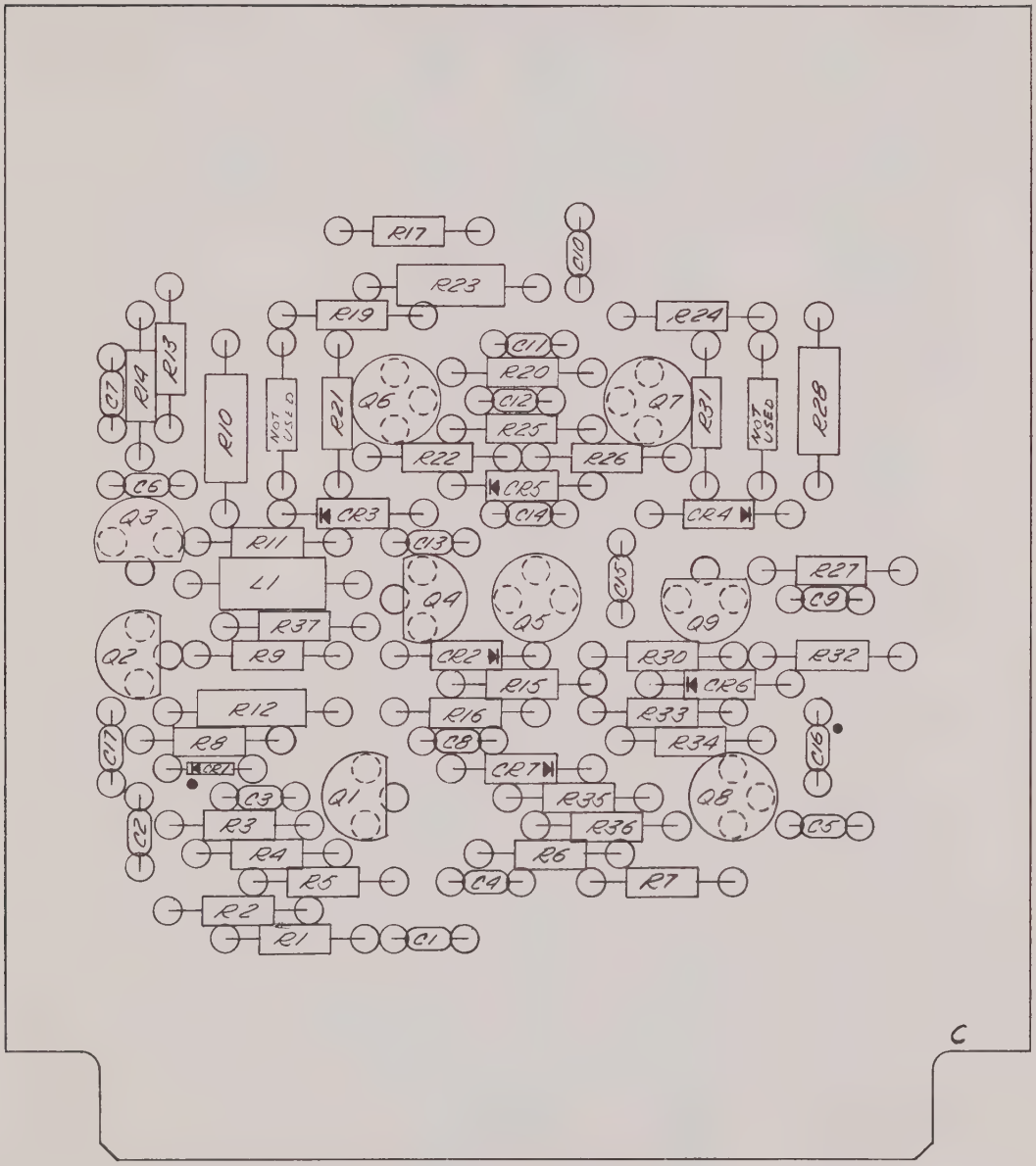
TIME BASE DIVIDER (A2)

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A2	887-427380-B	Time Base Divider Board	Beckman	1
C1, 2, 5	637-822754	Capacitor, F. Mica, 47pf, 500V, 5%	Electromotive DM15E470J0-500WV4CR	3
C3	637-822769	Capacitor, F. Mica, 24pf, 500V, 5%	Electromotive DM15C240J0-500WV4CR	1
C4, 7, 8, 11	633-827605	Capacitor, F. Cerm., 0.01μf, 25V	Sprague 19C604	4
C6	637-824498	Capacitor, F. Mica, 150pf, 300V, 5%	Electromotive DM15F151J0-300WV4CR	1
C9, 10	637-822785	Capacitor, F. Cerm., 39pf, 300V, 5%	Electromotive DM15C390K-500WV4CR	2
CR1 thru CR6	755-420893	Diode, Special	Beckman	6
CR7 thru CR10	755-431324(A)	Diode, Special	Beckman	4
Q1, 2, 4, 5	755-824880	Transistor, Germ., PNP, 150mW	Motorola 2N960	4
Q3	755-841100	Transistor, Type MPS 918	Motorola	1
R1, 2	601-822527	Resistor, F. Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	2
R3, 4, 8	601-822299	Resistor, F. Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	3
R5, 6	601-822334	Resistor, F. Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	2
R7, 9	601-822327	Resistor, F. Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	2
R10	601-822544	Resistor, F. Comp., 1.8K, 1/4W, 5%	Allen Bradley CB1825	1
R11	601-822297	Resistor, F. Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	1
R12, 15	601-822295	Resistor, F. Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	2
R13, 17	601-822306	Resistor, F. Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	2
R14	601-817735	Resistor, F. Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	1
R16	601-822326	Resistor, F. Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	1
R18, 21	601-823385	Resistor, F. Comp., 33Ω, 1/4W, 5%	Allen Bradley CB3305	2
R19, 20	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	2
	864-832780	Transistor Pad (Q1, 2, 4, 5 only)	Milton Ross 10034	4



NOTES:

1) RESISTORS:
   WATTAGE —— 1/4 W., UNLESS NOTED.
   TOLERANCE —— 5 %, " " .
2) CAPACITORS:
   VOLTAGE —— 300 V., " " .
   TOLERANCE —— 5 %, " " .
3) .01µF DISC ARE 25 V., -20+80 %.
4) * - DIODES, BECKMAN, A755-420893,
5) Δ - TRANSISTORS, BECKMAN, A755-424880

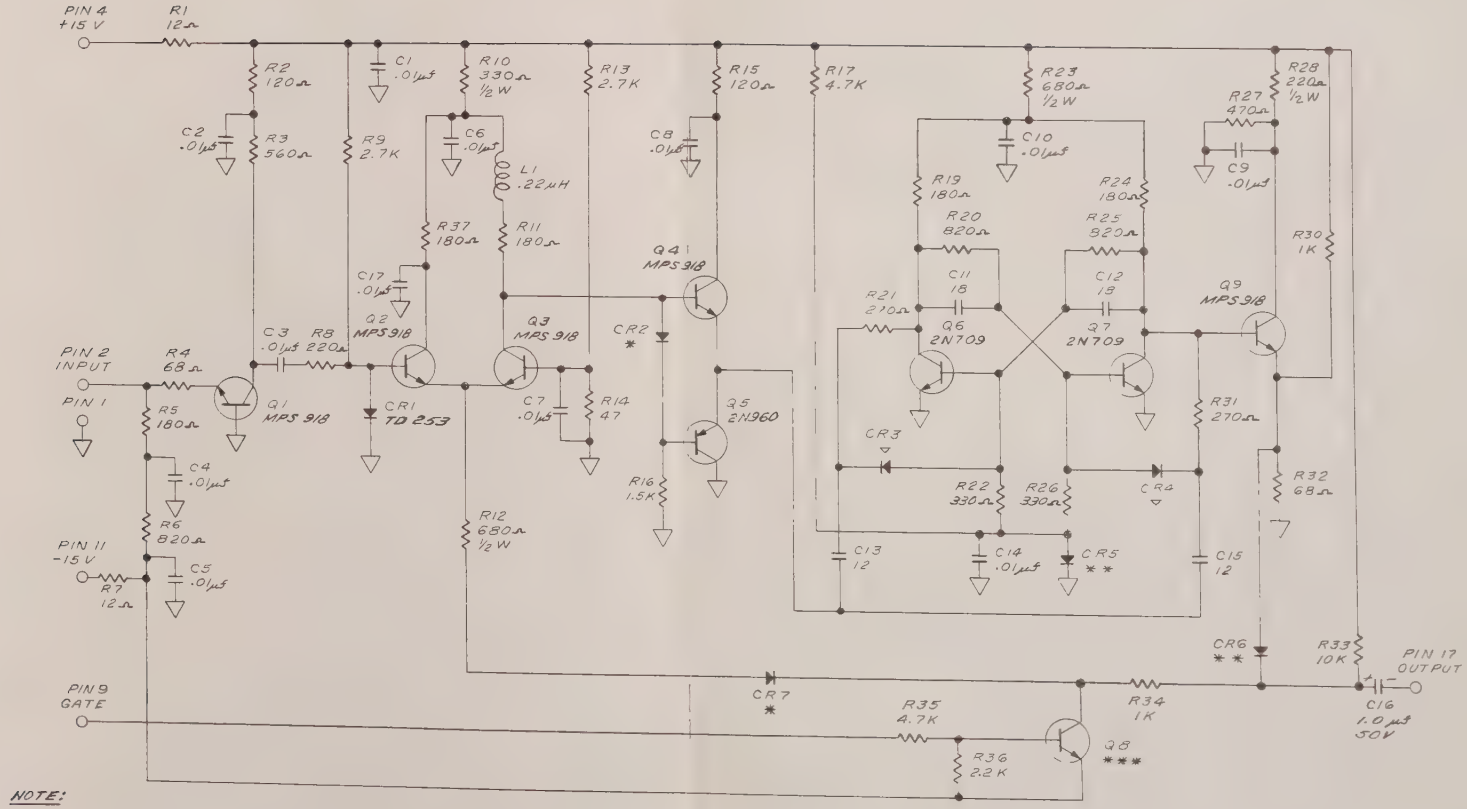


50 MHz BINARY AND GATE ASSEMBLY COMPONENT LAYOUT (A3)

PARTS LIST

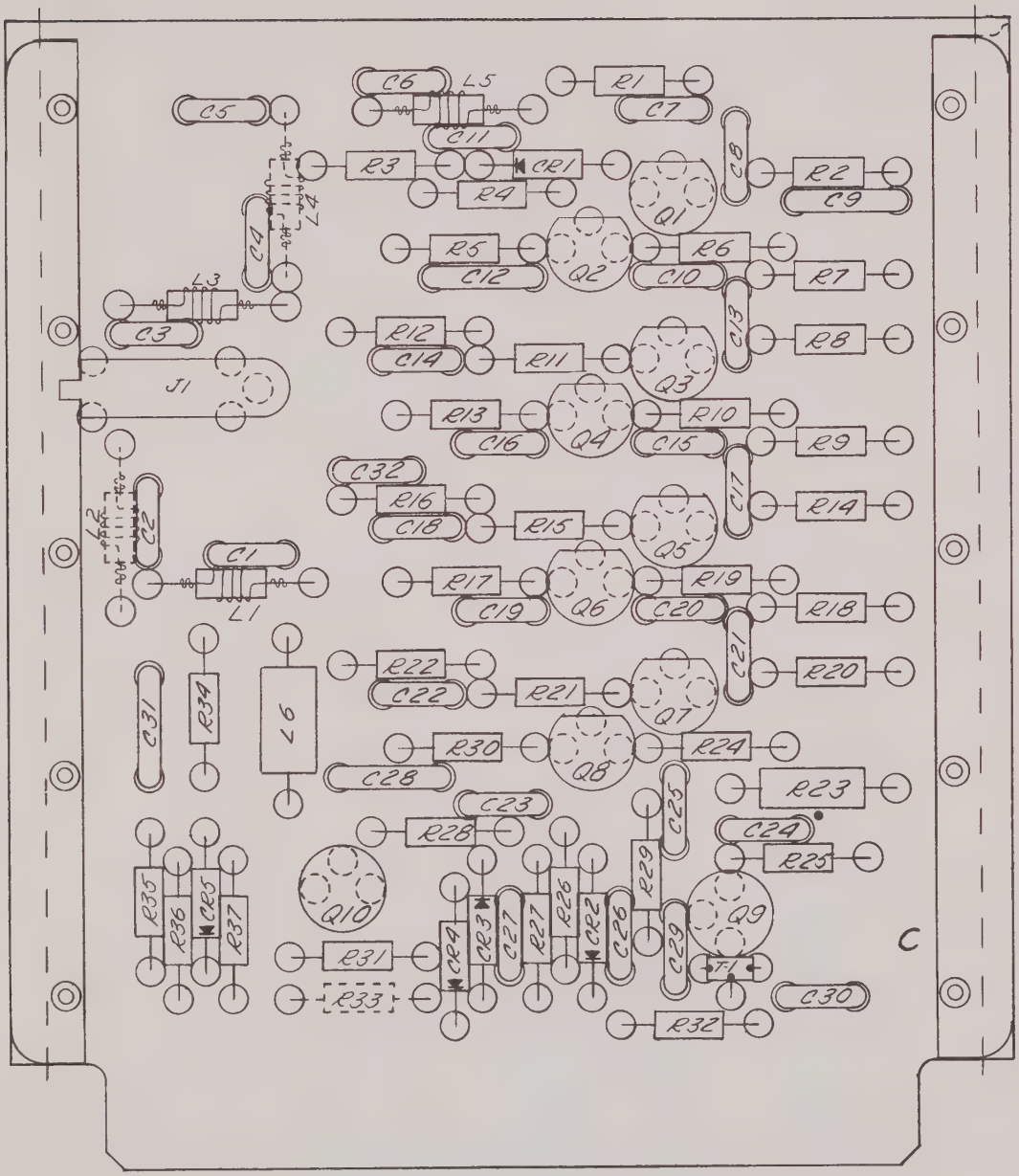
50 MHz BINARY AND GATE ASSEMBLY (A3)

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A3	887-427703C	50 MHz Binary and Gate Board	Beckman	1
C1 thru 10 C14, 17	633-827605	Capacitor, F.Cerm., 0.01μf, 25V	Sprague 19C604	12
C11, 12	637-827575	Capacitor, F.Cerm., 18pf, 500V, 5%	Electromotive DM15C180J0-500WV4CR	2
C13, 15	637-825070	Capacitor, F.Cerm., 12pf, 5%	Electromotive DM15C120J0-500WV4CR	2
C16	631-841451	Capacitor, F.Elect., 1M, 50V, 5%	Kemet Dept., K1P-50	1
CR1	755-836825	Diode, Tunnel, Type TD-253	GE	1
CR2, 7	755-404593	Diode, Silicon, Special	Beckman	2
CR3, 4	755-430460	Diode, Germanium, Special	Beckman	2
CR5, 6	755-420893	Diode, Germanium, Special DO-7	Beckman	2
L1	795-819899	Coil, 0.22μH, 20%	Delevan 1840-02	1
Q1 thru 4, Q9	755-841100	Transistor, NPN, Type MPS-918	Motorola	5
Q5	755-824880	Transistor, Type 2N960	Motorola	1
Q6, 7	755-819906	Transistor, Silicon, Type 2N709	Fairchild	2
Q8	755-410066	Transistor, Special	Beckman	1
R1, 7	601-823380	Resistor, F.Comp., 12Ω, 1/4W, 5%	Allen Bradley CB1205	2
R2, 15	601-823390	Resistor, F.Comp., 120Ω, 1/4W, 5%	Allen Bradley CB1215	2
R3	601-823396	Resistor, F.Comp., 560Ω, 1/4W, 5%	Allen Bradley CB5615	1
R4, 32	601-823389	Resistor, F.Comp., 68Ω, 1/4W, 5%	Allen Bradley CB6805	2
R5, 11, 19, 24, 37	601-823392	Resistor, F.Comp., 180Ω, 1/4W, 5%	Allen Bradley CB1815	5
R6, 20, 25	601-822306	Resistor, F.Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	3
R8	601-822327	Resistor, F.Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	1
R9, 13	601-822295	Resistor, F.Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	2
R10	601-015443	Resistor, F.Comp., 330Ω, 1/2W, 5%	Allen Bradley EB3315	1
R12, 23	601-015447	Resistor, F.Comp., 680Ω, 1/2W, 5%	Allen Bradley EB6815	2
R14	601-823387	Resistor, F.Comp., 47Ω, 1/4W, 5%	Allen Bradley CB4705	1
R16	601-822527	Resistor, F.Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	1
R17, 35	601-822297	Resistor, F.Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	2
R21, 31	601-823393	Resistor, F.Comp., 270Ω, 1/4W, 5%	Allen Bradley CB2715	2
R22, 26	601-823394	Resistor, F.Comp., 330Ω, 1/4W, 5%	Allen Bradley CB3315	2
R27	601-823395	Resistor, F.Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	1
R28	601-022939	Resistor, F.Comp., 220Ω, 1/2W, 5%	Allen Bradley EB2215	1
R30, 34	601-822308	Resistor, F.Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	2
R33	601-822324	Resistor, F.Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	1
R36	601-822328	Resistor, F.Comp., 2.2K, 1/4W, 5%	Allen Bradley CB2225	1
	864-412958	Transistor Converter Pad	Beckman (Q6, 7, 8 only)	3



NOTE:

1) RESISTORS:
   WATTAGE — ¼W., UNLESS NOTED.
   TOLERANCE — 5%, " "
2) CAPACITORS - IN PF, " "
3) .01μf DISC ARE 25 V. -20+80%.
4) * - DIODES, BECKMAN A755-404593,
5) ** - DIODES, BECKMAN A755-420893,
6) *** - TRANSISTOR, BECKMAN A755-410066,
7) ▽ DIODES: BECKMAN A755-430460



VIDEO AMPLIFIER ASSEMBLY COMPONENT LAYOUT (A4)

PARTS LIST

VIDEO AMPLIFIER ASSEMBLY (A4)

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A4	887-430977D	Video Amplifier Board	Beckman	1
C1, 6	637-857043	Capacitor, F. Mica, 82pf, 500V, 1%	Electromotive DM15F820F	2
C2, 5	637-857042	Capacitor, F. Mica, 89pf, 500V, 1%	Electromotive DM15F890F	2
C3, 4	637-857044	Capacitor, F. Mica, 112pf, 500V, 1%	Electromotive DM15F1120F	2
C7	637-822756	Capacitor, F. Mica, 15pf, 500V, 5%	Electromotive DM15C150J0-500WV4CR	1
C8	633-857046	Capacitor, F. Cerm., 0.0047pf, 200V, 5%	King CK06CW-472J	1
C9, 12, 28, 31	633-815873	Capacitor, F. Cerm., 0.33μf, 25V	Sprague 5C10A	4
C10	637-804740	Capacitor, F. Mica, 22pf, 500V, 5%	Electromotive CM15C220J03	1
C11, 13, 14, 16, 17, 18, 19, 21, 22, 23, 26, 27, 29, 30, 32	633-827605	Capacitor, F. Cerm., 0.01μf, 25V	Sprague 19C604	15
C15	637-825071	Capacitor, F. Mica, 27pf, 500V	Electromotive DM15E270J0-500WV4CR	1
C20	637-822976	Capacitor, F. Mica, 33pf, 500V, 5%	Electromotive DM15E330J0-500WV4CR	1
C24	631-841451	Capacitor, F. Elect., 1M, 50V, 5%	Kemet K1P50	1
C25	633-857047	Capacitor, F. Cerm., 0.001μf, 200V, 5%	King CK05CW-102J	1
CR1, 3, 4	755-420893	Diode, Germanium, Fast Switch	Beckman	3
CR2	755-827873	Diode, Silicon, D3530	Sylvania	1
CR5	755-404593	Diode, Silicon, Special	Beckman	1
J1	697-838675	Connector, Co-ax, P.C.	Amp. 50105-1	1
L1, 5	795-423824	Inductor, Fixed, 4T	Beckman	2
L2, 3, 4	795-423825	Inductor, Fixed, 11T	Beckman	3
L6	795-807881	Inductor, Fixed, F.F., 10μH	Delevan 1537-36	1
Q1 thru Q8	755-841100	Transistor, Silicon, NPN, MPS918	Motorola	8
Q9	755-419596	Transistor, Silicon, NPN, Special	Beckman	1
Q10	755-817964	Transistor, Silicon, NPN, 2N1420	Texas Instruments	1
R1, 5, 19, 24	601-823387	Resistor, F. Comp., 47Ω, 1/4W, 5%	Allen Bradley CB4705	4
R2, 8, 14, 20	601-822527	Resistor, F. Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	4
R3, 34	601-822306	Resistor, F. Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	2
R4, 21, 29	601-823395	Resistor, F. Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	3
R6	xxx-xxxxxx	Resistor, Factory selected value	Beckman	1
R7, 9, 18, 32	601-822295	Resistor, F. Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	4
R10	601-823389	Resistor, F. Comp., 68Ω, 1/4W, 5%	Allen Bradley CB6805	1
R11	601-822371	Resistor, F. Comp., 390Ω, 1/4W, 5%	Allen Bradley CB3915	1
R12, 13, 16, 17, 22	601-817735	Resistor, F. Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	5

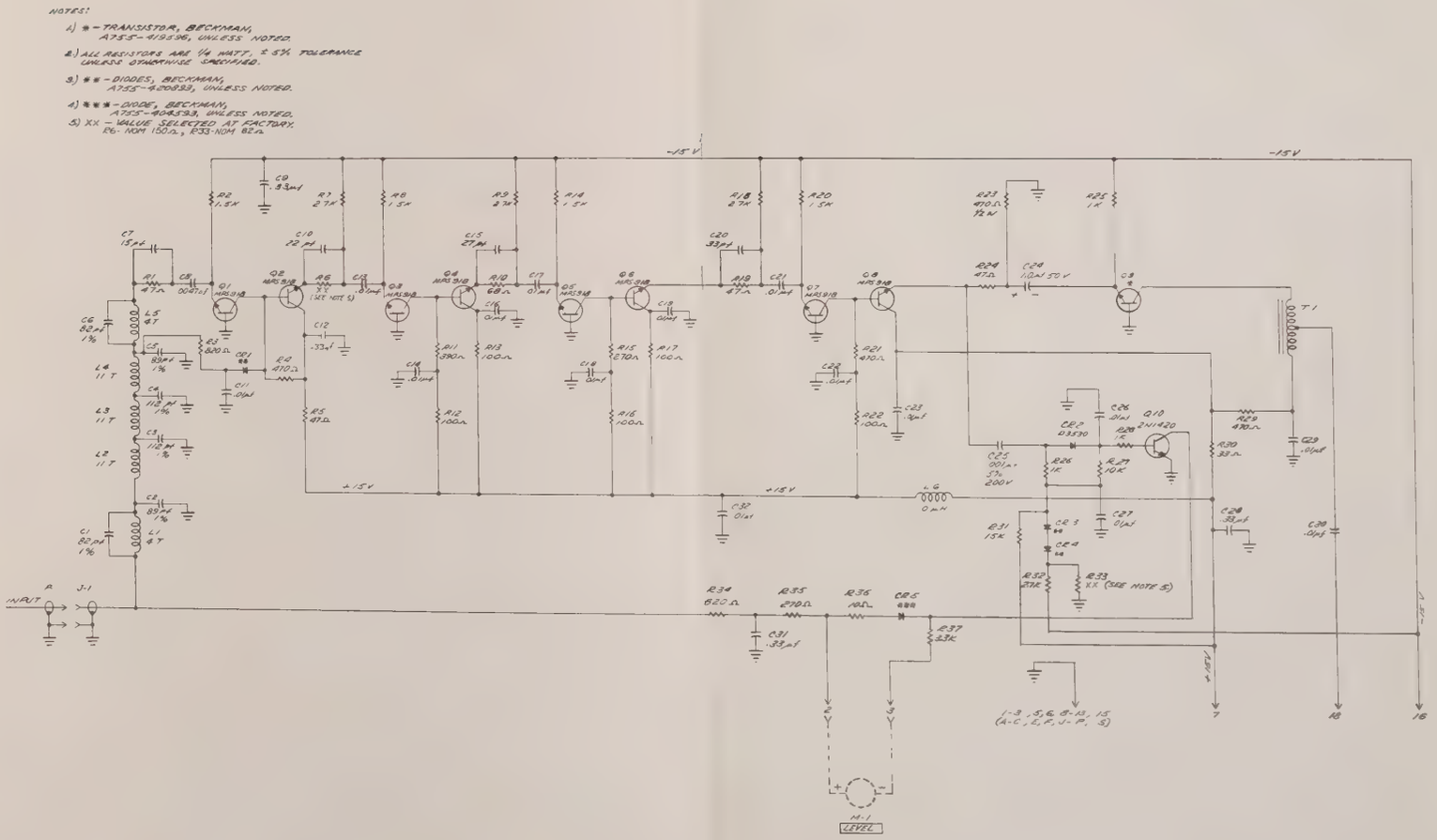
. . . continued

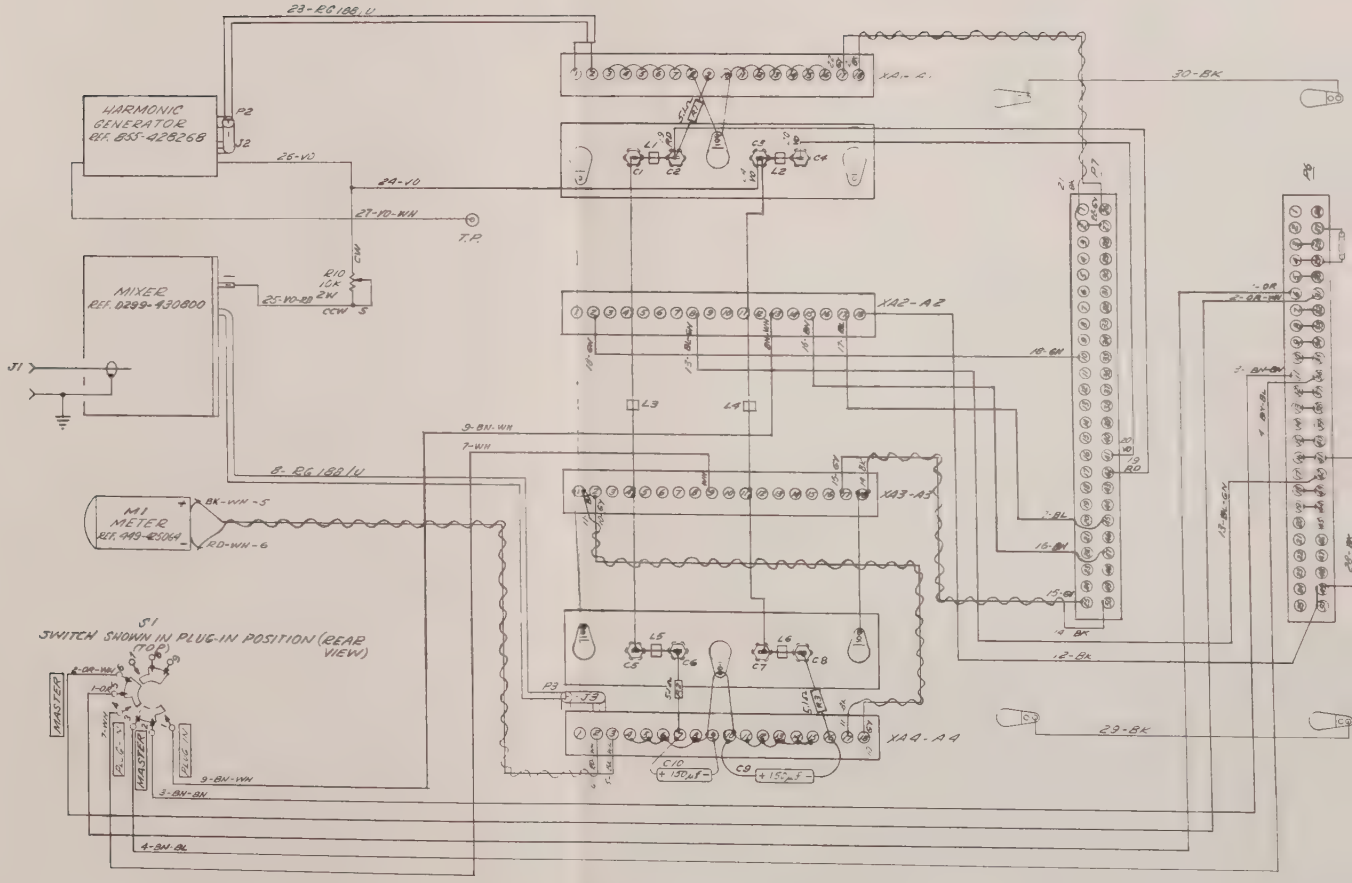
PARTS LIST

VIDEO AMPLIFIER ASSEMBLY (A4) - continued

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
R15, 35	601-823393	Resistor, F. Comp., 270Ω, 1/4W, 5%	Allen Bradley CB2715	2
R23	601-015446	Resistor, F. Comp., 470Ω, 1/2W, 5%	Allen Bradley EB4715	1
R25, 26, 28	601-822308	Resistor, F. Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	3
R27	601-822324	Resistor, F. Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	1
R30	601-823385	Resistor, F. Comp., 33Ω, 1/4W, 5%	Allen Bradley CB3305	1
R31	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	1
R33	xxx-xxxxxx	Resistor, Factory selected value	Beckman	1
R36	601-823379	Resistor, F. Comp., 10Ω, 1/4W, 5%	Allen Bradley CB1005	1
R37	601-822296	Resistor, F. Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	1
T1	792-423818	Transformer, 8T, CTR Tap	Beckman	1
	864-832780	Transistor Pad (Q9 only)	Milton Ross 10034	1
	864-412958	Transistor Pad (Q10 only)	Beckman	1

VIDEO AMPLIFIER
SCHEMATIC DIAGRAM


NOTES:
1) * - TRANSISTOR, BECKMAN, A755-419596, UNLESS NOTED.
2) ALL RESISTORS ARE 1/4 WATT, ± 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.
3) ** - DIODES, BECKMAN, A755-420893, UNLESS NOTED.
4) *** - DIODE, BECKMAN, A755-404593, UNLESS NOTED.
5) XX - VALUE SELECTED AT FACTORY. R6 - NOM 150Ω, R33 - NOM 82Ω.
-15 V
+15 V
INPUT
J-1
M-1
LEVEL
T1
Q10 2N1420
CR2 D3530
L6 0 mH
1-3, 5, 6, 8-13, 15 (A-C, E, F, J-P, S)



NOTE: All bare wire #18 GA., except for jumpers on P6 and P7.

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